THE GAMGRAM

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A few years ago, we took 3 trips to an airport with problems. An additive injector system of ours simply didn't always work correctly. We tried to determine the cause of the problem, but we could not duplicate the problem when we were there.

Fortunately, a wise old mechanic figured it out. He simply turned on the light and strobe (for night fueling) while the injector was running. The injector died. He explained it simply by saying:

> *"When you ran your tests, you turned on the lights first. You turned on the lights before you fueled, so the load on the electrical system was already there when you turned on the injector. If the injector was running and you turn the lights on, then the sudden load dropped the voltage for a moment, giving a voltage below the minimum voltage the injector requires. But it isn't the power cable that is at fault, the real problem was that the installer used a bracket for a ground and as the negative instead of running a copper wire to a good ground, and the framework he connected his ground to is stainless steel."*

It was a "word from the wise". The installation was simply not designed to protect the injector from sudden under voltage. The wise old mechanic simply ran a copper ground wire back to the battery and the problem was solved.

In the old days, electrical issues on refuelers were pretty simple. There was a power wire and a ground. If both were connected correctly – no problem.

This has changed in today's refueler vehicles for two reasons; materials of construction and more electrical load including advanced electronics.

Today, electronic apparatus requires a good negative, a good positive, and many also require a reliable ground. Both positive and negative wires should be copper, run to the source - often a "power distribution" point built for the purpose by the chassis manufacturer. All electronics, need dedicated wires for both positive and negative connections. That means that positive and negative wires should not be shared with any other equipment.

STAINLESS STEEL

in the old days, all frame work was steel. A ground connection was simple; connect to the vehicle anywhere, and that made up half your circuit. All you needed to run with copper wire was the power.

This changed a bit with aluminum framework and brackets, because sometimes the aluminum connection was subject to corrosion where it contacted steel. The difference in the metals caused corrosion, and a poor connection developed over time.

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The big change came with an increase in the use of stainless steel in cabinets and similar framework and brackets. The problem is that stainless steel is simply not as conductive as steel. The added resistance lowers the voltage level. It is logical to be concerned with the power wire being fully conductive, but most people never consider that the negative (or positive, on positive ground equipment, much more common outside the USA) is just as important. Simply said – Don't make an electrical connection through stainless steel, it lowers the actual voltage. This may only cause bulbs and lamps to be dim (lose brightness), but will cause a lot of serious problems with electronics.

ELECTRONICS

In the old days, electrical equipment was limited to lamps, lights and hose reel motors. The power draw (load) was low, except for hose reel motors, and they were designed to handle low voltage if it took place. Today, we have much more electrical equipment on refueler vehicles, and that equipment is much more sensitive to low voltage.

We have seen power levels on refueler vehicles as low as 8.5 VDC on 12 VDC vehicles. Electronics cannot be expected to run properly at these low voltages. There have been problems with electronic meters, additive injectors, control PLCs, digital pressure controls, GPS, hand-held electronics and even radios.

In some cases, the problems are due to undersized power distribution systems or undersized chassis battery (or batteries). That is to say that the chassis manufacturer simply didn't design the vehicle for all the electrical loads we are placing on them with a modern refueler design. In this case, an additional battery may not be enough to solve the problem, the main wires may have to be upgraded.

In other cases, the problems occur due to the installer. In one case, the mechanic installed an injector using the correct sized copper wire, but he “tapped into” our power wire to operate other equipment. This is like putting in a pipe big enough for the flow you need, then tapping off some flow for other purposes as well. The wire simply was not big enough to carry power to our system as well as other equipment properly, resulting in voltage drop, similar to pressure drop in liquid systems.

In other cases, the problem is due to the negative wire not being heavy enough (or the positive wire on a positive ground truck). The installer can also share the negative wire with other equipment, and the result is the same. The negative wire and positive wire must be the same size; they carry the same load (”flow” if you think of electricity as a “liquid”).

When building a new refueler, and even more importantly when modifying a vehicle in the field, we strongly suggest all new copper wire be used both for the positive wires and the negative wires.

When modifying existing trucks, don't “borrow” power from other equipment; don't share this new power with other equipment.

If you have an electrical problem, Don't forget it is just as likely to be on the negative wire as the positive wire. MOST importantly, keep high load equipment, like hose reel motors, off the same circuit as digital meter controls, injectors and other electronics.

One last bit of advice - When analyzing voltage, use a volt meter with a needle, not a digital display. Needle type (analog) meters give a more stable reading and are much more useful in systems where voltage may vary. Digital meters tend to give confusing readings.